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USING HERBICIDES ON ALFALFA AND BIRDSFOOT TREFOIL

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Small-seeded legumes are poor competitors with weeds for water, light and nutrients in the seedling stage. Seedling legumes are initially slow-growing, while weeds, in general, are fast growing plants. Weeds are also a serious problem in established legumes. Some common weeds found in legumes in Ohio are yellow rocket (*Barbarea vulgaris*), wild mustard (*Brassica* spp.), Canada thistle (*Cirsium arvense*), ragweed (*Ambrosia artemisiifolia*), lambsquarters (*Chenopodium album*), pigweed (*Amaranthus retroflexus*), crabgrass (*Digitaria* spp.) and foxtail (*Setaria* spp.). A serious problem in summer seeded legumes is volunteer wheat or oats from the grain dropped by the combine.

A common method of weed control is the use of a cereal companion crop, which may suppress weeds, but also competes with the seedling legumes. Herbicides might give satisfactory weed control and make it possible to eliminate this competition.

The use of herbicides in legumes has been rather limited. Legumes exhibit little or no tolerance to many of the herbicides now in commercial use. Recently, two herbicides, gamma-(2,4-dichlorophenoxy)-butyric acid [4-(2,4-DB)] and gamma-(2-methyl-4-chlorophenoxy)-butyric acid [4-(MCPB)] have shown promise in controlling some common broadleaf weeds in seedling legumes with little or no harm to the legumes. The present study evaluated these and other herbicides in controlling weeds in legumes.

REVIEW OF LITERATURE

The use of phenoxyacetic compounds in legumes has been rather limited because of the narrow margin of safety involved. Investigations on these and other compounds are too numerous to be cited in this paper; however, the more important findings will be discussed.

The phenoxyacetic compounds at rates above one-fourth pound per acre have been generally unsafe for legumes. Rates of 2,4-dichlorophenoxyacetic acid (2,4-D) which effectively controlled weeds also reduced the stand of legumes. The more serious injury has generally been associated with the use of ester formulations. In general, 2,4-D and 2-methyl-4-chlorophenoxyacetic acid (MCPA) were about equally

toxic to alfalfa, though MCPA was definitely less toxic to red clover. Both 2-4-D and MCPA were more toxic to legumes than 3,4-dichlorophenoxyacetic acid (3,4-D). Reduced legume stands were not always associated with a reduction in yield.

Probably the best of the older herbicides for use on seedling legumes, considering both weed control and effect on the forage species, has been 4,6-dinitro-*o*-*sec*-butylphenol (DNBP). The best results were usually obtained when DNBP was applied as an early (two to four true leaves) post-emergence treatment at one to two pounds per acre. Satisfactory results were obtained only when DNBP was applied in sufficient water to give good coverage.

Both 2,2-dichloropropionic acid (dalapon) and trichloroacetic acid (TCA) have given promise of controlling grassy weeds in some legumes. Dalapon up to four pounds per acre and TCA up to eight pounds per acre as early post-emergence treatments have given temporary injury to alfalfa and birdsfoot trefoil, but resulted in little or no stand reduction. Both herbicides were highly toxic to red clover.

Research during the past four years with the gamma-phenoxybutyric acids in the United States and elsewhere has shown that they and some other new herbicides offer greater margins of safety for use in forage legumes than was previously known (1, 2, 3, 4, 5, 6, 7, 8). Rates of 4-(2,4-DB) and 4-(MCPB) up to four pounds per acre have been used without completely eliminating the legumes present. In general, the gamma-phenoxybutyric compounds controlled many of the weeds the phenoxyacetic compounds controlled. However, higher rates of the gamma-phenoxybutyric compounds than of the acetic compounds were often required to produce satisfactory control.

MATERIALS AND METHODS

These experiments were conducted on the Agronomy farm of The Ohio State University at Columbus, Ohio. The soil was of the Miami catena, of silt loam and silty clay loam texture. A randomized complete block design with three replications was used in all experiments.

Good seedbeds were prepared and 250 pounds per acre of 0-20-20 fertilizer applied. All experiments were bandseeded. Heavy seeding rates (alfalfa at 12 pounds per acre and birdsfoot trefoil at 8 pounds per acre) were used to obtain good stands in all the experiments.

Applications of all herbicides were made with stainless steel Hudson hand sprayers. All treatments were made in 40 gallons of water per acre at a pressure of 40 pounds per square inch. The 4-(2,4-DB) and 4-(MCPB) used in these experiments were in dimethyl amine formulations, except in 1956, when both an ester and an amine were used. In this one test the ester was somewhat more active, but the differences between ester and amine were small, and the data have been averaged. The 2,4-D was always an amine formulation.

The herbicides were applied at several stages of legume growth from pre-emergence to the six-to-eight-trifoliate-leaves stage. Ratings were made on each experiment approximately one month after all the treatments had been applied, sometimes at a later date also. A rating of zero was given when there was no apparent injury and ten was given when all plants were completely killed. Each species was rated separately, based on comparisons with the nearest check plot. Both the 1957 and 1958 seedings of birdsfoot trefoil were rated later than the alfalfa seedings because of the slower establishment of birdsfoot trefoil.

Two inches of water were applied before making the seeding of Kansas common alfalfa on July 24, 1956. A mixture of ryegrass and German millet was sown to simulate grassy weeds. The July 25, 1957, seeding of Ranger alfalfa followed wheat that had been combined. Immediately after the wheat was harvested the area was plowed, the seedbed prepared, and allowed to lie fallow until the seeding was made. German millet was broadcast as a grassy weed.

In the experiment sown on April 25, 1957, ryegrass was broadcast as a grassy weed and German millet in the April 15, 1958 seeding. A natural infestation of lambsquarters and pigweed occurred in both seedings. In order to conserve land and number of applications half of each plot of the 1957 spring seeding was alfalfa and half was birdsfoot trefoil. The data obtained from the two legumes were treated as separate experiments but the data on weed control were treated as one experiment. The 1958 spring seedings were on separate areas.

By 1958, previous experiments had indicated that several treatments were of no value, either because of injury to the legumes or poor weed control. Many treatments applied at the two-to-four-leaf stage had given satisfactory weed control without seriously injuring the legumes, but this did not show how early the post-emergence treatments could be applied, so in the 1958 spring seedings of alfalfa and birdsfoot trefoil some of the more promising treatments were applied at emergence of the legumes.

RESULTS AND DISCUSSION

PRE-EMERGENCE TREATMENTS

Pre-emergence applications of 3-(3,4-dichlorophenyl)-1-*n*-butylurea (neburon) and the phenoxybutyric compounds were unsatisfactory (Appendixes 1 and 2). Neburon did not injure alfalfa or birdsfoot trefoil but gave poor weed control up to two pounds per acre. Both 4-(2,4-DB) and 4-(MCPB) gave poor weed control at one-fourth pound per acre, while higher rates resulted in severe injury to alfalfa and birdsfoot trefoil. At one pound per acre the phenoxybutyric compounds reduced the alfalfa stand 50 percent or more.

Rainfall for two days immediately following the pre-emergence applications on the 1956 summer seeding of alfalfa totaled 1.21 inches. The phenoxybutyric compounds were probably leached into the soil and brought into contact with the alfalfa and weed seeds, increasing their herbicidal effectiveness. Four pounds of 4-(MCPB) virtually eliminated all plant growth.

The only herbicide that showed promise as a pre-emergence treatment in legumes was ethyl-*N,N*-di-*n*-propylthiolcarbamate (EPTC) at four and six pounds per acre. Alfalfa and birdsfoot trefoil were not injured by EPTC and 90 percent or more of the grassy weeds were controlled. The control of pigweed and lambsquarters was only fair.

Although the over-all weed control by EPTC was not excellent (Figure 1), yields from the 1957 summer seeding of alfalfa indicated the control was satisfactory. A significant increase in yield indicated that most of the competition from weeds was eliminated during the establishment of the alfalfa. It seemed, also, that the broadleaf weeds were suppressed to the point where they were not seriously competitive with the seedling alfalfa.

EMERGENCE TREATMENTS

The emergence applications of 2,4-D and 4-(MCPB) were extremely toxic to alfalfa and birdsfoot trefoil (Figure 2). One-fourth and one-half pound per acre of 2,4-D gave poor broadleaf weed control, as did one-half and one pound of 4-(MCPB). However, 4-(2,4-DB) did not severely injure the legumes and gave good weed control up to two pounds per acre (Figure 3). In general, 4-(2,4-DB) was less toxic to the legumes and gave better weed control than the same rates of 4-(MCPB) in all the experiments.

Dalapon did not injure alfalfa or birdsfoot trefoil and gave excellent control of German millet at one and two pounds per acre. Lambsquarters and pigweed were not controlled by dalapon in any of the experiments.

Dalapon at two pounds per acre plus the phenoxybutyrics at one-half and one pound per acre applied at emergence gave excellent control of German millet. The dalapon plus 4-(2,4-DB) combinations did not seriously injure alfalfa and birdsfoot trefoil and controlled 70 to 80

Fig. 1.—This area was treated with EPTC. Weed control was not excellent but the yields from summer seeded alfalfa showed that it was satisfactory.

percent of the lambsquarters and pigweed. The combinations of dalapon and 4-(MCPB) controlled over 90 percent of the broadleaf weeds but also severely injured the legumes. Dalapon at two pounds per acre plus 4-(MCPB) at one pound per acre virtually eliminated birdsfoot trefoil.

TWO–TO–FOUR–LEAF STAGE

Post-emergence applications of 4-(2,4-DB) and 4-(MCPB) had a wider range of safety than 2,4-D. Rates of 4-(2,4-DB) up to four pounds did not seriously injure alfalfa but 2,4-D at one-half pound per

Fig. 2.—Emergence applications of 2,4-D and 4-(MCPB) were extremely toxic to both alfalfa and birdsfoot trefoil as the growth in this plot indicates.

acre reduced the alfalfa stand 50 percent. Two pounds per acre of 4-(2,4-DB) did not seriously injure birdsfoot trefoil but that rate of 4-(MCPB) injured it severely. At rates above two pounds per acre, 4-(MCPB) virtually eliminated birdsfoot trefoil (Figure 4). Alfalfa was not injured as much by 4-(MCPB) as birdsfoot trefoil. Birdsfoot trefoil was not injured as much as alfalfa by 2,4-D.

In general, the phenoxybutyrics at one pound per acre, or above, controlled 80 percent or more of the lambsquarters and pigweed (Figure 5). Increased weed control did not justify the use of the phenoxybutyrics at rates above two pounds per acre. Below one pound per acre, the phenoxybutyrics did not give satisfactory control of the broadleaf weeds.

Fig. 3.—A treatment of up to two pounds per acre of 4-(2,4-DB) did not severely injure the legumes and gave good weed control.

Dalapon at one, two and four pounds per acre gave fair to excellent control of German millet with little injury to alfalfa or birdsfoot trefoil. Ryegrass was not controlled by dalapon. Although there was some indication that dalapon injured alfalfa, it was not permanent. Two and four pounds per acre reduced the growth of lambsquarters and pigweed but did not control them.

The 1956 summer seeding of alfalfa indicated that dalapon at two pounds per acre was the best rate to use in combination with the phenoxybutyric compounds when both weed control and injury to legumes were considered. The results indicated that dalapon at two

Fig. 4.—When 4-(MCPB) was applied at rates above two pounds per acre it practically eliminated birdsfoot trefoil. Alfalfa was not as severely injured.

pounds per acre and the phenoxybutyrics at two pounds per acre controlled 95 percent or more of all weeds present (Figure 6). However, considering over-all weed control and injury to alfalfa and birdsfoot trefoil, the combination of dalapon at two pounds per acre and 4-(2,4-DB) at one pound per acre applied at the two-to-four-leaf stage was the best treatment (Figure 7). The combinations which included 4-(MCPB) were more toxic to legumes than those just mentioned. These results, in general, agree with the findings of other workers.

Fig. 5.—Applications of the phenoxybutyrics at one pound per acre controlled 80 percent or more of the lambsquarters and pigweed. Increased control did not justify rates above two pounds per acre.

Early post-emergence treatments that controlled both grasses and broadleaf weeds, such as the dalapon plus 4-(2,4-DB) combinations, increased alfalfa yields in the 1957 summer seeding. The less the weed competition during the first few weeks of growth, the more the alfalfa yielded the following year.

The application of DNBP at two and three pounds per acre caused little injury to alfalfa and gave 80 percent or more control of pigweed and lambsquarters. The control of German millet and ryegrass was poor. Above two pounds per acre, DNBP caused severe injury to birdsfoot trefoil.

Fig. 6.—A combination of dalapon at two pounds per acre and the phenoxybutyrics at the same rate controlled about 95 percent of all the weeds present.

In the 1957 spring seeding of alfalfa neburon at two and four pounds per acre controlled 80 percent or more of the pigweed and lambsquarters when applied at the two-to-four-leaf stage. However, in other experiments neburon gave poor control of all weeds.

These results are in contrast to the findings of Kerkin and Peters (4, 5), who found that treatments of neburon significantly increased alfalfa and birdsfoot trefoil yields and gave satisfactory control of both grassy and broadleaf weeds.

Fig. 7.—When the overall weed control and the damage to alfalfa and birdsfoot trefoil was considered, the best treatment seemed to be a combination of two pounds of dalapon and one pound of 4-(2.4-DB) per acre.

SIX–TO–EIGHT–LEAF STAGE

In general, all treatments applied at the six-to-eight leaf stage gave poor weed control and in some instances caused more injury to alfalfa and birdsfoot trefoil than post-emergence treatments at the earlier dates. Two pounds per acre of 4-(2,4-DB) and 4-(MCPB) gave satisfactory control of pigweed and lambsquarters, but one pound per acre of the phenoxybutyrics gave similar control of these weeds at the two-to-four-leaf stage. At one-half pound per acre, 2,4-D caused severe injury to the legumes and gave unsatisfactory control of weeds.

Dalapon gave slightly better control of ryegrass at the six-to-eight-leaf stage in 1957 than at the two-to-four-leaf stage. However, no treatment with dalapon gave satisfactory control of ryegrass. Other experiments indicated little difference between dates of application of dalapon.

In combination with the phenoxybutyrics, dalapon was used at four pounds per acre at the six-to-eight-leaf stage. These combinations were more toxic to alfalfa and birdsfoot trefoil and gave poorer over-all weed control than when applied at the two-to-four-leaf stage.

SUMMARY

Pre-emergence applications of all phenoxy herbicides in alfalfa and birdsfoot trefoil were unsatisfactory, giving poor weed control or severe injury to the legumes.

As post-emergence treatments on alfalfa and birdsfoot trefoil, the phenoxybutyric compounds had a much greater margin of safety than the phenoxyacetic compounds. One to two pounds per acre of 4-(2,4-DB) applied as an early post-emergence treatment caused little or no injury to the legumes and gave satisfactory control of lambsquarters and pigweed. In general, 4-(MCPB) was more toxic to alfalfa and birdsfoot trefoil and gave poorer weed control than 4-(2,4-DB).

One-fourth pound per acre of 2,4-D post-emergence did not harm alfalfa or birdsfoot trefoil. However, this rate gave poor control of most broadleaf weeds. Higher rates of 2,4-D caused considerable injury to the legumes.

Good to excellent control of German millet was obtained from post-emergence treatments of dalapon at one to four pounds per acre, with little injury to alfalfa and birdsfoot trefoil. Ryegrass and broadleaf weeds were not controlled by dalapon.

Combinations of dalapon and the phenoxybutyrics gave good overall weed control in alfalfa and birdsfoot trefoil. Dalapon at two pounds per acre plus 4-(2,4-DB) at one pound per acre applied at the two-to-four-leaf stage was the most satisfactory combination from the standpoint of weed control and lack of injury to the legumes.

Pre-emergence treatments of EPTC at three to six pounds per acre gave excellent control of grassy weeds and fair control of pigweed and lambsquarters without injuring alfalfa or birdsfoot trefoil. This herbicide gave a significant increase in yield of 1957 summer seeded alfalfa.

Post-emergence applications of DNBP up to three pounds per acre gave good control of most broadleaf weeds and poor control of grassy weeds with some injury to alfalfa and birdsfoot trefoil. Above three pounds per acre, DNBP severely injured these crops.

Pre- and post-emergence treatments of neburon from one to four pounds per acre did not injure alfalfa or birdsfoot trefoil. Grass control was poor and the control of lambquarters and pigweed ranged from poor to excellent.

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APPENDIX 1.—Herbicides on Summer Seeded Alfalfa
1956 seeding made July 24, rated September 12
1957 seeding made July 25, rated September 17
0 = no effect; 10 = complete kill
Average of three replications

Treatment		Ratings of effect on							
		Alfalfa		German millet		Pigweed		Lambs-quarters	
Herbicide	Lb/A	1956	1957	1956	1957	1956	1957	1956	1957
		Pre-emergence							
4-(2,4-DB)	¼	2.3	0.0	1.3	1.2	0.3	2.3	1.7	1.0
4-(2,4-DB)	½	2.7	2.8	3.3	2.7	1.8	6.5	4.8	6.3
4-(2,4-DB)	1	4.3	6.7	5.2	6.8	5.5	6.0	7.7	4.2
4-(MCPB)	¼	5.0	0.0	1.8	0.0	6.3	0.0	5.0	0.0
4-(MCPB)	½	8.4	2.3	6.2	0.7	6.0	5.5	4.0	2.0
4-(MCPB)	1	9.4	4.3	8.0	4.0	8.7	4.8	8.7	2.3
Neburon	½	0.0	--	0.0	--	0.0	--	0.0	--
Neburon	1	0.0	--	0.8	--	1.0	--	1.0	--
Neburon	2	0.0	--	0.5	--	4.3	--	3.7	--
EPTC	6	--	0.0	--	10.0	--	5.5	--	6.0
		2 to 4 trifoliate leaves							
4 (2,4-DB)	½	0.0	0.0	2 6	1.5	9 7	4.2	10.0	3.8
4-(2,4-DB)	1	0.0	0.0	4.7	1.2	9.3	7.8	10.0	8.1
4-(2,4-DB)	2	1.0	0.0	7 8	3.2	10.0	10.0	10.0	10.0
4-(2,4-DB)	4	1.0	0.5	8.3	3.3	10.0	10.0	10.0	10.0
4-(MCPB)	½	0.0	0.0	2.5	2.7	9.3	4.2	9.8	6.3
4-(MCPB)	1	0.0	0.2	6.7	3.3	9.3	7.8	9.3	9.2
4-(MCPB)	2	0.7	1 0	7.0	4 7	10.0	8.8	10.0	10.0
4-(MCPB)	4	1.7	1.6	7.3	4 5	10.0	10.0	10.0	10.0
Dalapon	1	1.7	0.0	5.3	7.3	0.0	0.0	0.0	0.0
Dalapon	2	2.7	0.0	9.2	9.2	0.0	1.2	0.0	0.5
Dalapon	4	3.0	1.3	9.7	9.5	0.0	2.2	0.0	2.2
Neburon	1	--	0.0	--	1.5	--	0.7	--	0.2
Neburon	2	--	0.0	--	1.0	--	1.7	--	2.0
Neburon	4	--	0.0	--	2.3	--	4.8	--	4.0
Dal. + 4-(2,4-DB)	2 + ½	0.7	0.3	9.3	9.7	10.0	9.6	9.8	10.0
Dal. + 4-(2,4-DB)	2 + 1	--	0.5	--	9.8	--	9.7	--	10.0
Dal. + 4-(2,4-DB)	2 + 2	--	0.7	--	9.8	--	9.8	--	10.0
Dal. + 4-(MCPB)	2 + ½	0.3	0.8	9.7	9.7	8.7	8.2	9.0	9.3
Dal. + 4-(MCPB)	2 + 1	--	0.7	--	9.5	--	9.2	--	9.3
Dal. + 4-(MCPB)	2 + 2	--	2.5	--	9.7	--	9.8	--	9.8
2,4-D	¼	--	0.8	--	4.5	--	7.8	--	5.3
2,4-D	½	--	0.7	--	1.8	--	8.8	--	8.8
DNBP	1	--	0.0	--	1.3	--	4.5	--	4.0
DNBP	2	0.0	0.0	9.2	2.8	8.3	7.8	9.0	8.3
DNBP	3	--	0.0	--	3.3	--	8.7	--	8.0

Treatment		Ratings of effect on							
		Alfalfa		German millet		Pigweed		Lambs-quarters	
Herbicide	Lb/A	1956	1957	1956	1957	1956	1957	1956	1957
		6 to 8 trifoliate leaves							
4-(2,4-DB)	½	0.0	0.0	2.3	0.8	6.7	7.0	8.0	6.5
4-(2,4-DB)	1	0.0	0.0	1.7	1.3	7.7	8.2	8.3	8.3
4-(2,4-DB)	2	0.0	0.0	3.0	2.0	9.3	9.2	9.5	9.2
4-(2,4-DB)	4	--	0.0	--	3.2	--	9.5	--	9.5
4-(MCPB)	½	0.0	0.0	2.3	0.7	8.3	4.7	10.0	4.0
4-(MCPB)	1	1.0	0.3	4.3	1 8	9.0	8.2	9.3	8.3
4-(MCPB)	2	0.0	0.5	5.0	1.3	9.0	8.2	9.8	9.2
4-(MCPB)	4	--	1.2	--	2.0	--	8.2	--	9.7
Neburon	1	0.0	--	1.3	--	0.0	--	0.0	--
Neburon	2	0.0	--	0.8	--	0.0	--	0.0	--
Neburon	4	0.0	--	0.3	--	0.0	--	0.0	--
Dalapon	1	--	0.0	--	6 8	--	0.7	--	0.7
Dalapon	2	--	0.0	--	6.3	--	0.7	--	0.7
Dalapon	4	--	0.8	--	8.3	--	3.2	--	2.2
Dal. + 4-(2,4-DB)	4 + ½	--	0.5	--	6.7	--	7.8	--	8.2
Dal. + 4-(2,4-DB)	4 + 1	0.0	0.8	7.0	7.5	9 3	9.3	10.0	9.5
Dal. + 4-(2,4-DB)	4 + 2	0.0	1.0	6.0	7.2	9.7	9.0	9.8	9.5
Dal. + 4-(MCPB)	4 + ½	--	6 0	--	6 2	--	9.0	--	8.7
Dal. + 4-(MCPB)	4 + 1	--	1.3	--	5.5	--	9.0	--	9.0
Dal. + 4-(MCPB)	4 + 2	--	2.5	--	7.8	--	9.2	--	9.5
2,4-D	¼	--	1.7	--	1.0	--	8.2	--	7.2
2,4-D	½	--	4.2	--	2.8	--	7.0	--	7.5
DNBP	1	--	0.0	--	2.8	--	7.3	--	7.0
DNBP	2	0.0	0.2	5.0	3.7	5.3	9.2	5.3	9.7
DNBP	3	--	0.8	--	4.7	--	9.8	--	9.8

APPENDIX 2.—Herbicides on Spring Seeded Alfalfa and Birdsfoot Trefoil

1957 alfalfa seeding made April 25, rated July 1
1958 alfalfa seeding made April 15, rated June 12
1957 birdsfoot seeding made April 25, rated August 15
1958 birdsfoot seeding made April 15, rated June 22
0 = no effect; 10 = complete kill
Average of three replications

Treatment		Ratings of effect on									
		Alfalfa		Birdsfoot trefoil		Rye-grass	German millet	Pigweed		Lambs-quarters	
Herbicide	Lb/A	1957	1958	1957	1958	1957	1958	1957	1958	1957	1958
Pre-emergence											
4-(2,4-DB)	¼	1.7	--	0.0	--	1.0	----	7.0	----	6.0	----
4-(2,4-DB)	½	2.3	--	2.3	--	1.2	----	6.4	----	4.0	----
4-(2,4-DB)	1	6.3	--	3.0	--	0.8	----	8.9	----	8.6	----
4-(MCPB)	¼	0.9	--	1.5	--	1.5	----	4.1	----	3.3	----
4-(MCPB)	½	3.8	--	1.2	--	1.0	----	5.9	----	5.4	----
4-(MCPB)	1	5.7	--	6.5	--	0.2	----	8.0	----	8.7	----
EPTC	2	0.3	0.0	0.0	0.0	8.8	5.8	8.6	1.0	8.5	2.7
EPTC	4	0.3	0.0	0.0	0.0	9.0	10.0	1.2	7.0	5.4	9.5
EPTC	6	--	0.0	0.0	0.0	--	9.8	----	7.0	----	9.0
Emergence											
4-(2,4-DB)	½	--	0.0	--	0.3	--	6.3	----	5.5	----	4.3
4-(2,4-DB)	1	--	0.3	--	1.7	--	7.0	----	8.1	----	8.1
4-(2,4-DB)	2	--	1.3	--	1.7	--	9.2	----	9.3	----	9.3
4-(MCPB)	½	--	2.0	--	0.8	--	2.3	----	3.7	----	3.3
4-(MCPB)	1	--	3.0	--	3.8	--	6.0	----	3.7	----	3.3
4-(MCPB)	2	--	7.1	--	3.7	--	8.7	----	9.8	----	9.5
Dalapon	1	--	0.0	--	0.0	--	10.0	----	0.0	----	0.0
Dalapon	2	--	0.0	--	0.0	--	9.8	----	0.2	----	0.2
Dal. + 4-(2,4-DB)	2 + ½	--	0.9	--	0.0	--	9.7	----	7.0	----	7.7
Dal. + 4-(2,4-DB)	2 + 1	--	1.8	--	1.2	--	9.5	----	8.0	----	8.0
Dal. + 4-(MCPB)	2 + ½	--	3.8	--	1.0	--	9.8	----	9.3	----	9.6
Dal. + 4-(MCPB)	2 + 1	--	6.7	--	9.2	--	9.5	----	9.0	----	9.0
2,4-D	¼	--	3.0	--	2.7	--	3.9	----	0.0	----	3.3
2,4-D	½	--	7.9	--	2.8	--	8.0	----	6.3	----	4.0
2 to 4 trifoliate leaves											
4-(2,4-DB)	½	0.0	0.0	0.2	0.0	2.7	0.0	5.9	4.3	7.1	4.3
4-(2,4-DB)	1	0.0	0.0	0.0	0.0	2.0	4.1	10.0	9.8	10.0	9.8
4-(2,4-DB)	2	0.5	0.0	0.0	0.3	3.5	7.1	9.8	9.9	9.9	9.9
4-(2,4-DB)	4	0.0	1.5	5.2	1.7	2.8	9.1	9.9	10.0	9.9	10.0
4-(MCPB)	½	0.9	0.0	0.7	0.8	0.5	1.0	5.8	2.5	6.5	2.5
4-(MCPB)	1	0.2	0.2	1.7	3.0	3.8	3 3	6.5	9.5	8.3	9.5
4-(MCPB)	2	1.0	0.3	3.4	6.0	1.5	6.7	9.0	10.0	9.5	10.0
4-(MCPB)	4	6.0	3.1	6.7	9.5	3.9	5.5	9.9	10.0	9.9	10.0

Treatment		Ratings of effect on									
		Alfalfa		Birdsfoot trefoil		Rye-grass	German millet	Pigweed		Lambs-quarters	
Herbicide	Lb/A	1957	1958	1957	1958	1957	1958	1957	1958	1957	1958
2 to 4 trifoliate leaves											
Dalapon	1	0.0	0.0	1.6	0.0	1.3	9.8	0.4	0.0	1.3	0.0
Dalapon	2	0.5	0.0	0.2	0.0	3.2	10.0	2.0	0.0	3.7	0.0
Dalapon	4	0.6	0.3	0.0	0.0	5.5	10.0	4.4	2.5	4.8	2.5
Dal. + 4-(2,4-DB)	2 + ½	0.9	0.2	0.0	0.5	3.0	9.9	8.2	9.7	8.8	9.7
Dal. + 4-(2,4-DB)	2 + 1	0.8	0.2	0.0	0.5	4.4	10.0	9.4	10.0	9.8	10.0
Dal. + 4-(2,4-DB)	2 + 2	1.9	1.0	0.8	1.8	4.4	10.0	9.8	10.0	10.0	10.0
Dal. + 4-(MCPB)	2 + ½	1.0	0.7	1.7	1.3	2.4	10.0	7.3	9.7	6.7	9.7
Dal. + 4-(MCPB)	2 + 1	2.2	1.7	1.5	3.0	2.8	10.0	8.3	10.0	8.3	10.0
Dal. + 4-(MCPB)	2 + 2	3.2	2.0	5.7	9.3	4.1	9.8	9.2	9.8	9.8	9.8
2,4-D	¼	0.4	0.3	0.0	0.0	1.3	1.7	6.6	9.2	8.5	8.8
2,4-D	½	5.3	5.3	1.5	2.5	1.3	3.4	8.3	9.5	8.9	9.5
Neburon	1	0.2	--	1.0	--	2.0	----	4.3	----	5.7	----
Neburon	2	1.8	--	2.0	--	1.7	----	8.0	----	8.4	----
Neburon	4	0.7	--	1.3	--	4.3	----	8.9	----	9.5	----
DNBP	1	0.5	--	0.0	--	0.8	----	3.6	----	4.1	----
DNPB	2	1.2	--	3.0	--	2.5	----	5.4	----	8.7	----
DNPB	3	1.7	--	5.8	--	4.0	----	8.8	----	9.4	----
6 to 8 trifoliate leaves											
4-(2,4-DB)	½	0.0	--	6.0	--	2.3	----	6.1	----	4.8	----
4-(2,4-DB)	1	0.0	--	3.2	--	2.0	----	6.4	----	5.9	----
4-(2,4-DB)	2	1.0	--	2.8	--	1.8	----	8.9	----	8.2	----
4-(2,4-DB)	4	2.6	--	4.7	--	3.7	----	9.3	----	8.5	----
4-(MCPB)	½	0.7	--	0.2	--	1.8	----	4.6	----	3.9	----
4-(MCPB)	1	3.2	--	0.2	--	3.3	----	6.8	----	4.9	----
4-(MCPB)	2	3.4	--	4.7	--	3.0	----	8.3	----	9.5	----
4-(MCPB)	4	4.5	--	5.3	--	2.7	----	9.7	----	9.5	----
Dalapon	1	0.0	--	0.8	--	5.8	----	0.5	----	0.5	----
Dalapon	2	0.0	--	0.5	--	5.2	----	1.5	----	1.2	----
Dalapon	4	0.5	--	0.0	--	8.2	----	3.3	----	2.8	----
Dal. + 4-(2,4-DB)	4 + ½	1.3	--	0.0	--	7.8	----	5.6	----	7.2	----
Dal. + 4-(2,4-DB)	4 + 1	2.8	--	0.3	--	8.6	----	6.3	----	8.7	----
Dal. + 4-(2,4-DB)	4 + 2	4.0	--	0.2	--	7.9	----	8.2	----	9.3	----
Dal. + 4-(MCPB)	4 + ½	2.5	--	0.5	--	6.1	----	5.3	----	7.6	----
Dal. + 4-(MCPB)	4 + 1	3.3	--	0.8	--	6.8	----	5.1	----	8.2	----
Dal. + 4-(MCPB)	4 + 2	4.7	--	1.3	--	4.8	----	7.7	----	8.5	----
2,4-D	¼	3.8	--	0.8	--	3.7	----	6.8	----	7.3	----
2,4-D	½	5.2	--	3.7	--	2.9	----	4.6	----	8.2	----
DNBP	1	0.0	--	0.7	--	3.0	----	4.5	----	4.3	----
DNBP	2	0.0	--	0.3	--	3.8	----	5.8	----	4.8	----
DNBP	3	1.7	--	2.8	--	6.3	----	5.8	----	5.8	----